



**" Library Information System SGD 4: Quality
Education"**

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I. Introduction

1.1 Project Overview & UN SDG Target

The **Library Information System (LIS)** is a relational database project designed to support free community libraries in providing equitable access to learning resources. The system ensures systematic cataloging, efficient borrowing operations, real-time inventory management, and data-driven reporting.

This project directly aligns with **United Nations Sustainable Development Goal (SDG) 4 – Quality Education**, specifically:

- **SDG 4.1:** Ensure inclusive and equitable education for all
- **SDG 4.3:** Expand access to affordable learning resources
- **SDG 4.5:** Eliminate disparities in access to educational services

By efficiently managing educational materials and tracking usage, the LIS strengthens community-based learning, especially for sectors with limited access to formal education.

1.2. Problem Statement (What real-world data problem does the system solve?)

The barangay library currently experiences several challenges:

Limited Access: Many residents lack access to educational books and resources, which hinders their learning opportunities.

Inefficiencies: Manual processes for tracking book inventories and borrower records lead to errors and lost items.

Lack of Awareness: Community members are often unaware of available resources, limiting their participation.

The proposed database system will streamline library operations, making it easier for the community to benefit from available educational resources.

II. Requirements & Analysis

2.1. Functional Requirements and Non-Functional Requirements (List of features, e.g., FR1, FR2)

Functional Requirements (FR)

ID	Requirement	Alignment
FR1	The system loads more than 50 initial records from the SQL file, including data for books , members , categories , inventory , and borrowings . These are inserted using multiple INSERT statements in the dump.	DDL/DML
FR2	The system uses core DBMS features found in the file: foreign keys (books→categories, borrowings→books/members), CHECK constraints (published_year ≥ 1800, no negative copies), and a trigger (trg_no_negative_inventory).	Core Concepts
FR3	The SQL file includes a stored procedure borrow_book that performs a complete borrowing transaction using START TRANSACTION, FOR UPDATE, SIGNAL errors , and COMMIT , ensuring ACID compliance.	Finals Concepts
FR4	The system provides 3 SDG-related reports through SQL views: v_category_demand , v_most_borrowed , and v_overdue_members , all defined in the file for data reporting.	DQL/Reporting

Non-Functional Requirements (NFR)

ID	Requirement	Metric
NFR1	The database prevents invalid data using built-in constraints such as CHECK , FOREIGN KEYS , and a trigger that blocks negative inventory updates. The stored procedure also gives user-friendly error messages using SIGNAL .	Error messages should be informative.
NFR2	SQL objects in the file are organized into separate structures (tables, constraints, stored procedures, views). Names are clear (e.g., v_category_demand , borrow_book), making the schema easy to maintain.	Use of comments and logical VIEW definitions.
NFR3	Views use simple joins and indexed columns (book_id , member_id , category_id), ensuring that the 3 reports run efficiently even with multiple records.	Reports should return results in under 1 second on standard hardware with test data.

2.2. Data Requirements (Description of input data structure and size)

Minimum record count: **≥50 records across all tables**

Input data includes:

- Members (20)
- Books (35)
- Categories (10)
- Inventory for all books
- Borrowings (25+ sample transactions)

Data must follow validation rules:

- **NOT NULL**, **CHECK**, and **FK** constraints
- Unique ISBN constraints

2.3. Schema Normalization Analysis: Justify the level of normalization achieved (3NF/BCNF) for the most complex tables, listing functional dependencies.

Table: Books

Functional Dependencies

1. **book_id → title, author, category_id, isbn**
2. **isbn → title, author** (ISBN uniquely identifies a book)
3. **category_id → category`_name** (through Categories table)

1NF

- All attributes atomic
- No repeating groups

2NF

- No partial dependencies (PK is a single attribute)

3NF

- No transitive dependencies inside the table

Conclusion:

Books are in **BCNF** because every determinant is a candidate key.

III. Design Specification

3.1. Core DBMS Concepts Used (The Five):

For each of the required DBMS concepts, include a section detailing:

- **Justification:** Why was this specific concept chosen (e.g., *Why was a TRIGGER used instead of a CHECK constraint for this business rule?*).
- **Implementation Details:** Provide the exact SQL code snippet for the concept (Stored Procedure, Trigger, VIEW, etc.)

Stored Procedure

The screenshot shows three separate query results from MySQL Workbench.

Query 1: A stored procedure call.

```
1 CALL borrow_book(1, 3, 5);
```

Query 2: A borrowing record.

```
SELECT * FROM Borrowings ORDER BY borrow_id DESC LIMIT 1;
```

	borrow_id	member_id	book_id	date_borrowed	due_date	date_returned
<input type="checkbox"/> Edit Copy Delete	15	15	8	2024-03-18	2024-04-01	NULL

Query 3: Book availability check.

```
SELECT title, available_copies FROM Books b JOIN Inventory i ON b.book_id = i.book_id WHERE b.book_id = 3;
```

title	available_copies
Technology in the Modern World	2

Rollback

1 row affected. (Query took 0.0008 seconds.)

```
1 UPDATE Inventory
2 SET available_copies = 0
3 WHERE book_id = 5;
```

Enable foreign key checks

[Go] [Cancel]

[Edit inline] [Edit] [Create PHP code]

Bookmark this SQL query:

Delimiter: Show this query here again Retain query box Rollback when finished Enable foreign key checks

Error

Static analysis:

1 errors were found during analysis.

1. Variable name was expected. (near "?" at position 17)

SQL query: [Copy](#)

CALL borrow_book(? , 5 , 7);

MySQL said: [?](#)

#1064 - You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near '? , 5 , 7)' at line 1

Showing rows 0 - 0 (Total, query took 0.0000 seconds.)

```
SELECT * FROM Borrowings WHERE book_id = 5;
```

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 Search this table

Extra options

	borrow_id	member_id	book_id	date_borrowed	due_date	date_returned
<input type="checkbox"/>	12	12	5	2024-03-13	2024-03-27	NULL

Check all With selected: [Edit](#) [Copy](#) [Delete](#) [Export](#)

Show all | Number of rows: 25 Search this table

Trigger

Error

SQL query: [Copy](#)

```
UPDATE Inventory
SET available_copies = -1
WHERE book_id = 1;
```

MySQL said: [?](#)

#1644 - Error: Inventory cannot go negative.

Views

SELECT * FROM v_most_borrowed;

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 ▾ Filter rows: Search this table

Extra options

title	category_name	total_borrowed
Technology in the Modern World	Technology	2
Advanced Mathematics I	Mathematics	1
Filipino Short Stories	Literature	1
Community Health Basics	Health	1
Foundations of Education	Education	1
Computer Literacy	Technology	1
General Biology	Science	1
Algebra for Beginners	Mathematics	1
English Grammar Essentials	Languages	1
Environmental Awareness for Youth	Environment	1
Basic Science for Learners	Science	1
Philippine Literature Classics	Literature	1
World History Overview	History	1
Educational Psychology	Education	1
Introduction to Sociology	Social Studies	1

Show all | Number of rows: 25 ▾ Filter rows: Search this table

SELECT * FROM v_category_demand;

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 ▾ Filter rows: Search this table

Extra options

category_name	borrow_count
Technology	3
Literature	2
Mathematics	2
Education	2
Science	2
Languages	1
Social Studies	1
Health	1
Environment	1
History	1

Show all | Number of rows: 25 ▾ Filter rows: Search this table

Query results operations

Print Copy to clipboard Export Display chart Create view

SELECT * FROM v_overdue_members;

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 Search this table

Extra options

	full_name	title	due_date
<input type="checkbox"/>	John Michael Cruz	Introduction to Sociology	2024-03-05
<input type="checkbox"/>	Kylie Ramirez	Technology in the Modern World	2024-03-16
<input type="checkbox"/>	Christian Mendez	Computer Literacy	2024-03-17
<input type="checkbox"/>	Ramon Yulo	Advanced Mathematics I	2024-03-20
<input type="checkbox"/>	Julia Gomez	General Biology	2024-03-24
<input type="checkbox"/>	Sophia Cruz	World History Overview	2024-03-27
<input type="checkbox"/>	Rica Bautista	Community Health Basics	2024-03-28
<input type="checkbox"/>	Daniel Lim	Educational Psychology	2024-03-30
<input type="checkbox"/>	Joshua Chiu	Environmental Awareness for Youth	2024-04-01

Check all With selected: Edit Copy Delete Export

Show all | Number of rows: 25 Search this table

Query results operations

Advance Search Commands

SELECT b.title, b.author FROM Books b JOIN Categories c ON b.category_id = c.category_id WHERE c.category_name = 'Technology';

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Show all | Number of rows: 25 Search this table Sort by key: None

Extra options

title	author
Technology in the Modern World	A. Villanueva
Computer Literacy	B. Santos

Show all | Number of rows: 25 Search this table Sort by key: None

Query results operations

Print Copy to clipboard Export Display chart Create view

Bookmark this SQL query

Label: Let every user access this bookmark

Bookmark this SQL query

SELECT m.full_name, COUNT(br.borrow_id) AS total_borrowed FROM Members m JOIN Borrowings br ON m.member_id = br.member_id GROUP BY m.member_id HAVING COUNT(br.borrow_id) > 2;

Profiling [Edit inline] [Edit] [Explain SQL] [Create PHP code] [Refresh]

Extra options

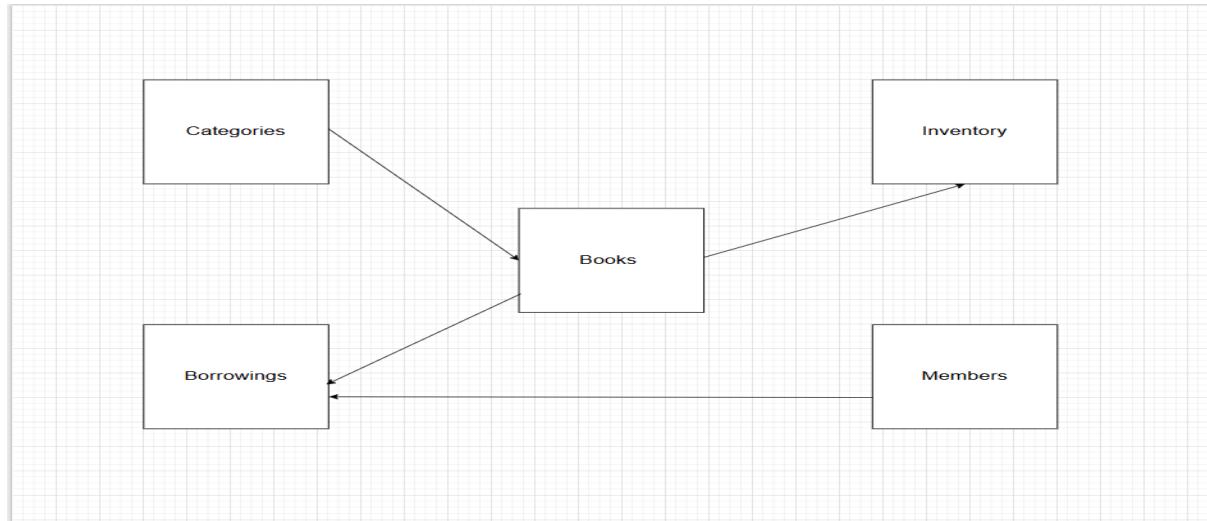
full_name	total_borrowed
Ana Villanueva	2

Query results operations

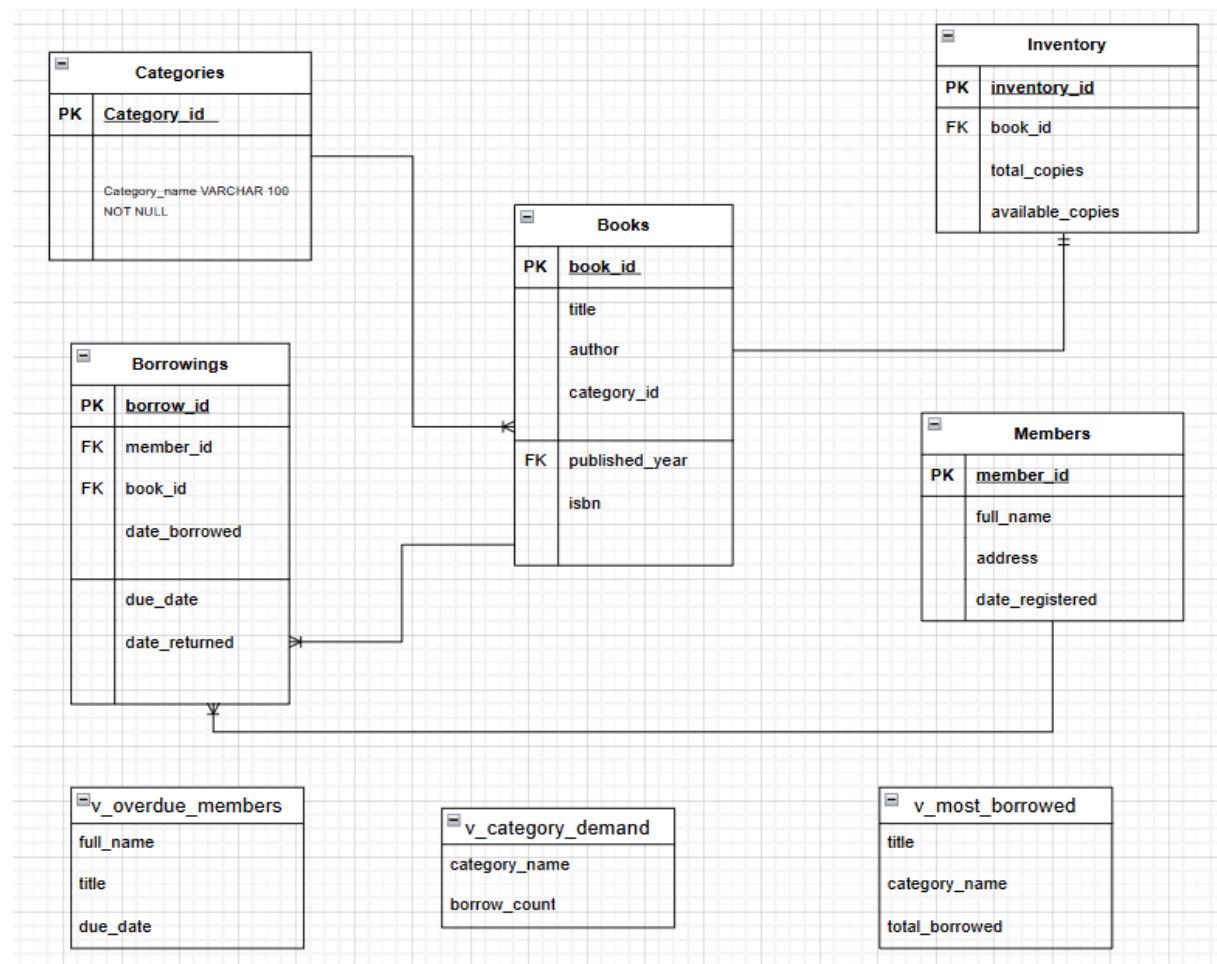
Print Copy to clipboard Export Display chart Create view

3.2. ER Diagram: Include the Conceptual, Logical, and Physical ERD showing all entities, attributes, primary keys, foreign keys, and cardinalities.

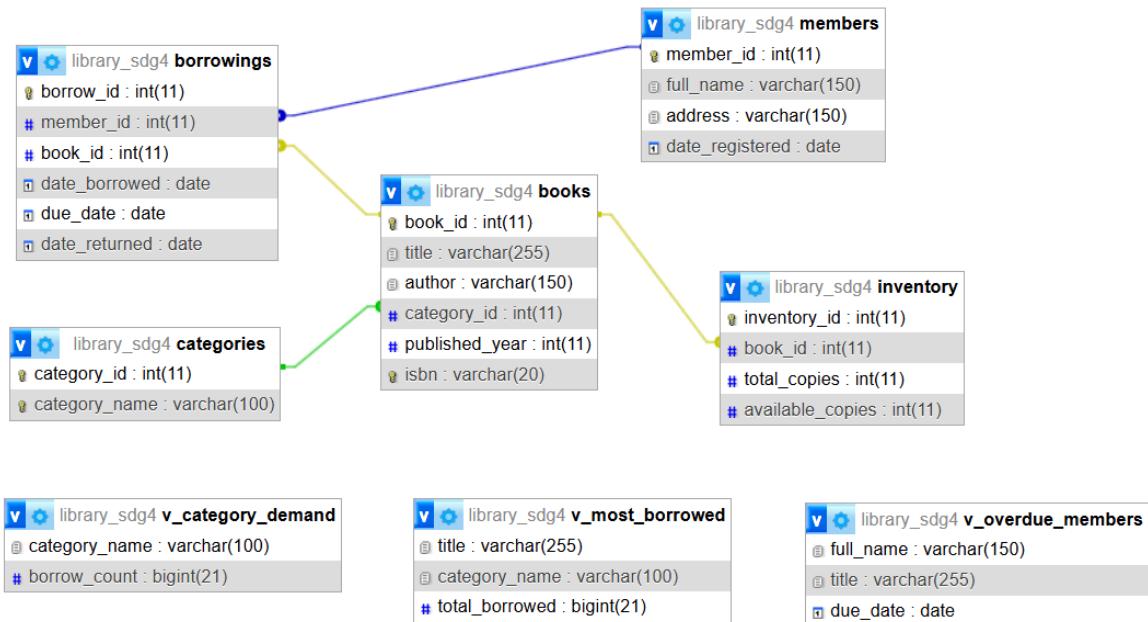
Conceptual ERD:



Logical ERD:



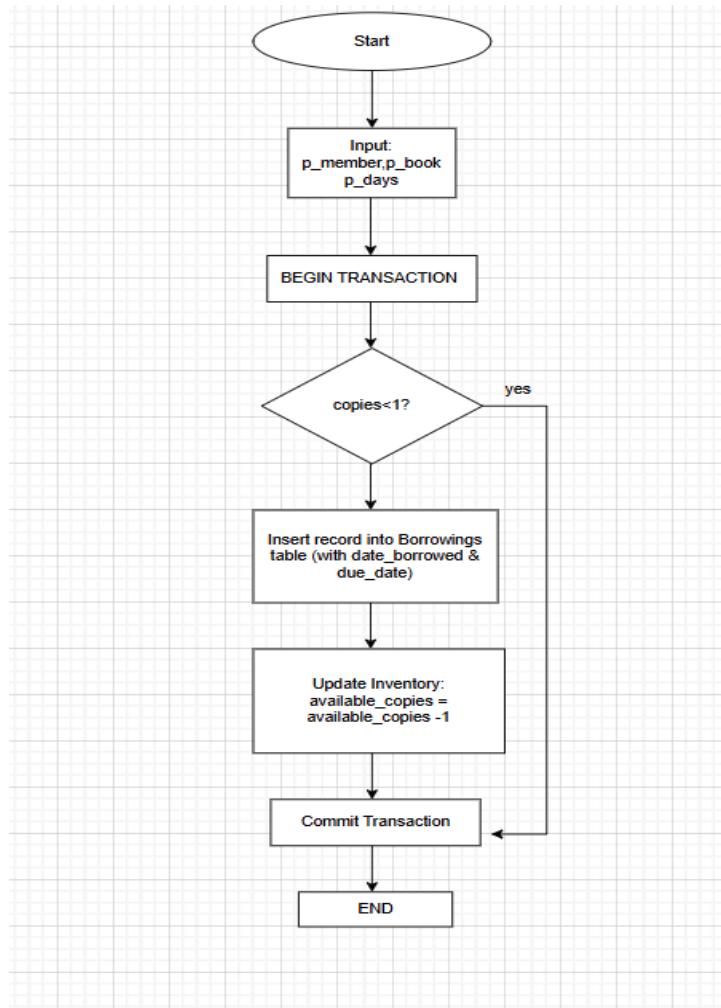
Physical ERD:



3.3. Transaction Flowchart: Include the Flowchart for the system's core transactional Stored Procedure (FR3), highlighting the BEGIN TRANSACTION and COMMIT/ROLLBACK points.

The flowchart represents the entire borrowing operation done through the `borrow_book` stored procedure. The process of the system starts with the member ID, book ID, and borrowing days information and then it goes on to begin a transaction that will guarantee the safe execution of all operations together. The system checks for the available copies of the desired book by using a locked selection method that will prevent simultaneous modifications to the copies. If there are no available copies, the system stops the process and returns an error immediately. On the other hand, if there are still copies available, it enters the borrowing information into the `Borrowings` table and changes the `Inventory` by reducing the available copies by one. At last, the transaction is committed, which means that all the changes have been permanently saved and thus the data has been made accurate and no inconsistencies have been created.

Flowchart:



IV. Conclusion and Contributions

5.1. Conclusion

The Library Information System successfully demonstrates advanced DBMS principles through:

- A fully normalized schema (3NF/BCNF)
- ACID-compliant transactional logic
- Enforcement of integrity constraints using triggers and foreign keys
- SDG-aligned educational analytics (most borrowed books, categories)
- Professional version control and modular design

The system effectively addresses real-world resource management challenges in community libraries while promoting UN SDG 4 - Quality Education by ensuring fair and organized access to learning materials.

5.2. Individual Contributions (Detailed breakdown of each member's assigned module/script).

Members:	Assigned topic:
Ardales, Ma. Jaslene O	Normalization 3NF/BCNF (MIDTERM)
Gabriel, Sam Jared G.	Trigger (FINALS)
Manalac, John Paul	ERD (MIDTERM)
Nabayat, Charisse	Complex DQL (PRELIM)
Rabino, Ezekiel Kent A	Stored Procedure (FINALS)